BUILDING ENERGY CODES PROGRAM

Setting the Standard Newsletter

U.S. Department of Energy • Office of Energy Efficiency and Renewable Energy

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# Basements: Advantages and Disadvantages of Finishing Basements During Initial Construction of the Home

The 2000 and 2003 Editions of the International Energy Conservation Code (IECC) require basement walls to be insulated if the basement is considered part of the heated and/or cooled living space (conditioned space). If the basement is initially designed to be unfinished, insulation is required in the basement ceiling. The 2003 IECC requires floors over unheated spaces or basement walls that define the conditioned space (Section 502.2.3.3 or 502.2.3.6) to meet the applicable overall thermal transmittance factor (U-factor) or the minimum R-value based on the prescriptive specifications on an individual component basis. In basic terms this means, if the basement is unconditioned, the floor above the basement (basement ceiling) must be insulated and meet all the requirements of the IECC for floors over an unconditioned space. If the basement is considered part of the conditioned building envelope, the basement walls must be insulated and meet all the requirements of the IECC for basement walls. The requirements in the code vary depending on location and climate conditions. Requirements in the IECC include some of the following: Insulation Installation (Section 102.4), Moisture Control (Section 502.1.1), and Caulking and Sealants (Section 502.1.4.2).

Many homes are being constructed with unfinished basements to reduce initial costs. In most cases, the homeowner eventually finishes the basement for additional living space by installing basement wall insulation. Because most basements are eventually occupied, the advantages and disadvantages of conditioning the basement should be thoroughly reviewed prior to permitting and construction.

Table 1 provides a list of advantages and disadvantages of basement wall insulation compared to basement ceiling insulation.

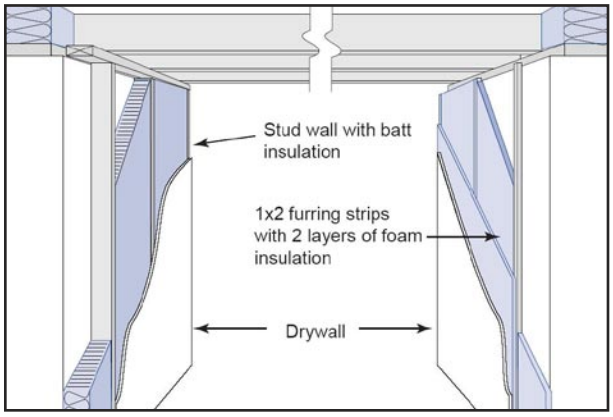
**Table 1: Basement Wall Insulation Compared to Basement Ceiling Insulation**

| Advantages of Basement Wall Insulation | Disadvantages of Basement Wall Insulation |
|---|---|
| • More easily achieves continuous thermal and air leakage boundaries because basement ceilings are typically penetrated with electrical wiring, plumbing, ductwork, and doors<br>• Requires little, if any, increase in the size of heating and cooling equipment – the heat loss and air leakage through the basement ceiling is similar to that through the basement's exterior walls<br>• Eliminates the need for insulation of the piping and ductwork to provide energy efficiency or to protect against freezing because they are located within the house's conditioned volume | • Eliminates the requirement of insulating the basement ceiling<br>• Costs may exceed those for insulating the basement ceiling depending on the materials and approach selected<br>• Installing insulation improperly may cause moisture and mold problems<br>• May require non-invasive termite detection systems, such as termite baits, in termite-prone areas |

Basement wall insulation can be installed on either the exterior or interior of the walls (see Figures 1 and 2). Moisture must be addressed in conditioned basements. (According to the 2003 IECC, Section 502.1, the design shall not create conditions of accelerated deterioration from moisture condensation.) From a building science perspective, the preferred method is insulating the

*Figure 1: Exterior Basement Wall Insulation*

*Figure 2: Interior Basement Wall Insulation*



wall on the exterior with rigid insulation suitable for below-grade installations, such as extruded polystyrene or rigid fiberglass. Table 2 lists several advantages and disadvantages of exterior and interior basement wall insulation.

Several of the following advantages and disadvantages in Table 2 have been generated from other written sources. For more detailed information on basement insulation techniques, refer to the sources/citations listed below.

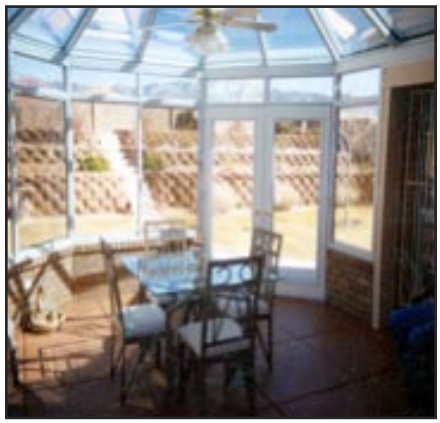
**Table 2: Basement Wall Insulation Choices**

| Exterior Basement Wall Insulation | Interior Basement Wall Insulation |
|---|---|
| **Advantages** | **Advantages** |
| • Minimizes thermal bridging and reduces heat loss through the basement walls.<br>• Protects the basement wall from the effects of the freeze-thaw cycle in extreme climates.<br>• Reduces the potential for condensation on interior basement wall surfaces<br>• Protects the exterior damp proofing coating from damage during back-filling<br>• Can serve as a capillary break to moisture intrusion | • Reduces installation costs significantly in an existing building compared with exterior insulation which requires digging up and exposing the exterior basement wall<br>• Offers a wider choice in materials because many types of insulation can be used<br>• Eliminates the threat of insect infestation within the insulation |
| **Disadvantages** | **Disadvantages** |
| • Is expensive to install in an existing building unless the wall is already going to be exposed to install a perimeter drainage system<br>• Is often susceptible to insect infestation<br>• May be more difficult to install because contractors may not be familiar with proper detailing procedures | • Often requires a fire-rated covering because many insulation types release toxic gases when ignited and paper facings do not meet building code flame spread requirements<br>• Does not protect the exterior damp proofing coating like exterior insulation<br>• May become saturated by moisture weeping through the foundation walls if the perimeter drainage is poor<br>• Requires careful attention to infiltration sealing of the interior wall |

Building Science Corporation: Basement Insulation Systems, http://www.buildingscience.com/resources/foundations/basement_insulation_systems.pdf
Kansas State University: Residential Foundation Insulation, http://www.energycodes.gov/implement/pdfs/lib_ks_residential_found_insulation.pdf
Minnesota Department of Commerce Energy Information Center: Basement Insulation, http://www.state.mn.us/ebranch/admin/buildingcodes/printouts/basement.pdf
U.S. Dept. of Energy, Energy Efficiency and Renewable Energy, Technology Fact Sheet:
http://www.southface.org/web/resources&services/publications/technical_bulletins/BI-Basement%20insulation%2002-776.pdf

# Special Code Requirements for Sunrooms and Additions

The prescriptive envelope component criteria (Section 502.2.5) in the 2003 International Energy Conservation Code (IECC) is an alternative compliance path for sunrooms and additions to existing residential buildings and structures.



Sunrooms must meet the following criteria to use the sunroom compliance path (Table 1):
- An area <500 square feet
- >40% glazing of gross exterior wall and roof area
- Thermally isolated
- Not used as a kitchen or sleeping quarters
- Separate heating/cooling system or zone.

Additions must meet the following criteria to use the alternative compliance path (Table 2):
- An area <500 square feet
- <40% glazing of gross exterior wall and roof area.

Sunrooms and/or additions that meet the criteria defined in the 2003 IECC can show compliance by using the Prescriptive Envelope Component Criteria table shown below in Table 1 for the designated heating degree days (HDD) applicable to the location.

**TABLE 1 : 2003 IECC/Sunrooms (Section 502.2.5)**

| HDD (Heating Degree Day) | MAX | MINIMUM | | | | | |
|---|---|---|---|---|---|---|---|
| | Fenestration U-factor | Ceiling R-value | Wall R-value | Floor R-value | Basement wall R-value | Slab perimeter R-value and depth | Crawl space wall R-value |
| 0 – 1,999 | 0.75 | R-19 | R-13 | R-11 | R-5 | R-0 | R-5 |
| 2,000 – 3,999 | 0.5 | R-19 | R-13 | R-19 | R-8 | R-5, 2 ft. | R-10 |
| 4,000 – 5,999 | 0.5 | R-19 | R-13 | R-21 | R-10 | R-9, 2 ft. | R-19 |
| 6,000 – 8,499 | 0.5 | R-24 | R-13 | R-21 | R-11 | R-13, 4 ft. | R-20 |
| 8,500 – 12,999 | 0.5 | R-24 | R-13 | R-21 | R-19 | R-18, 4 ft. | R-20 |

**Solar Heat Gain Coefficient (SHGC) of .40 mandatory for locations < 3,500 HDD**

| TABLE 2 : 2003 IECC/Additions (Section 502.2.5) | | | | | | | |
|---|---|---|---|---|---|---|---|
| HDD (Heating Degree Day) | MAX | MINIMUM | | | | | |
| | Fenestration U-factor | Ceiling R-value | Wall R-value | Floor R-value | Basement wall R-value | Slab perimeter R-value and depth | Crawl space wall R-value |
| 0 – 1,999 | 0.75 | R-26 | R-13 | R-11 | R-5 | R-0 | R-5 |
| 2,000 – 3,999 | 0.5 | R-30 | R-13 | R-19 | R-8 | R-5, 2 ft. | R-10 |
| 4,000 – 5,999 | 0.4 | R-38 | R-18 | R-21 | R-10 | R-9, 2 ft. | R-19 |
| 6,000 – 8,499 | 0.35 | R-49 | R-21 | R-21 | R-11 | R-13, 4 ft. | R-20 |
| 8,500 – 12,999 | 0.35 | R-49 | R-21 | R-21 | R-19 | R-18, 4 ft. | R-20 |

SHGC of .40 mandatory for locations < 3,500 HDD

The REScheck software tools cannot currently be used to show compliance using the prescriptive criteria alternative compliance defined for sunrooms and additions in the 2003 IECC. Compliance can be shown by including requirements for the applicable minimum component insulation and maximum U-factor for fenestration on the building plans. Attaching the applicable table to your building plans and highlighting the applicable criteria will help expedite approval.

# Exterior Lighting Requirement Changes

The newly published ANSI/ASHRAE/IESNA Standard 90.1-2004, Energy Standard for Buildings Except Low-Rise Residential Buildings, includes many major changes from the previous version published in 2001. Many of these changes provide for a more stringent set of requirements aimed at eliminating energy waste and inefficiency in buildings. Several changes have occurred in the lighting requirements section, including a completely revised set of interior lighting power densities and a new exterior lighting section.

The new exterior lighting section was developed in response to concerns that the treatment of exterior requirements in the previous standard was insufficient. The previous 2001 version only required limits for a few generic exterior categories, an efficacy level for larger wattage lamps and basic controls. The 2004 version completely revises this section with a new greatly expanded table of lighting power limits covering a wide variety of exterior surfaces and activities. The development process was aimed at providing exterior power limits for most known applications while maintaining a safe, effective, and quality lighted environment. The latest illumination recommendations from the IESNA 9th edition handbook were used as the basis for a series of exterior lighting models. Where applicable, information from various current IESNA Recommended Practice and Design Guides publications was also used to ensure accurate and effective models. These models and analysis also incorporated current product efficiency data and practicing designer experience and consensus.

The new table format provides two general sections for tradable and non-tradable lighting applications. The tradable application group includes some of the more common parking, grounds, entrance, canopy, and sales areas. The lighting power allowed for these areas can be traded among areas, which allows flexibility in design depending on the needs of the building exterior activities. The non-tradable applications are generally more activity-specific such as teller machines, loading docks, guard stations, drive-up windows, and parking at 24-hour retail entrances. These areas cannot be traded and must be used only where applicable.

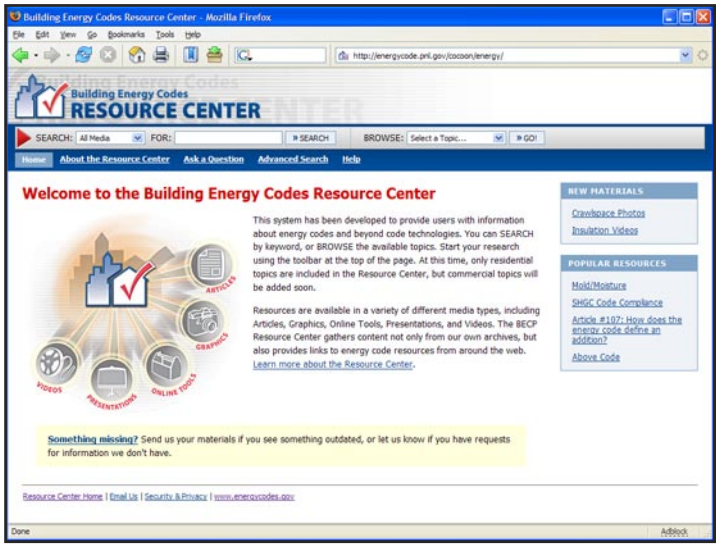
The new requirements also provide further design flexibility in the form of an additional 5% allowance to the total exterior lighting allowed. This extra 5% value can be applied wherever the design calls for extra lighting for accent or general illumination. A more complete set of exceptions to the exterior lighting requirements has also been provided to exempt applications where the requirements might cause a safety concern or unduly restrict the lighting needs of the activity, such as lighting for industrial production, material handling, transportation sites, and associated storage areas, and lighting for theatrical purposes, including performance, stage, film, and video production.

The new requirements are a step toward producing more efficient buildings, as they have been designed to eliminate wasteful design and inefficient application. As with most minimum efficiency codes, many designers will find their designs are already more energy efficient than required by these criteria. For others the criteria will be the catalyst for a fresh look at previous design strategies, leading to more effective new designs and increased energy efficiency and savings.

To obtain a copy of the ASHRAE/IESNA 90.1-2004 go to www.ashrae.org

# New online Energy Codes Resource Center offers a one-stop source of information on building energy efficiency codes

The U.S. Department of Energy (DOE) has launched the Building Energy Codes Resource Center—a comprehensive, online resource that links users to energy codes and beyond-code construction techniques and technologies. The interactive website, which went live October 1, 2004, offers detailed information on topics ranging from how to frame window headers for additional insulation to the latest research on mold and moisture. Initially, most of the information will focus on residential codes and beyond code construction. Information regarding commercial buildings will be available this summer 2005.




The Resource Center provides information on hundreds of topics in a variety of different formats, including:

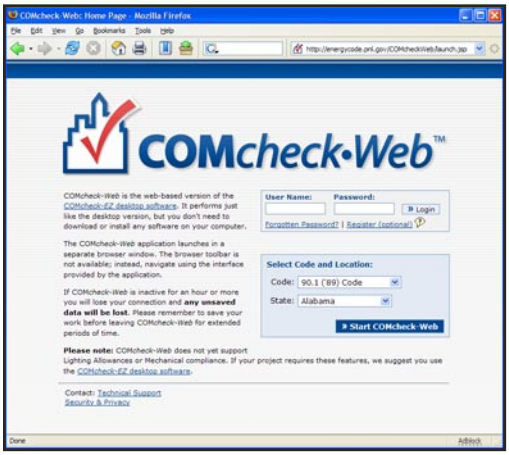
- Articles — Fact sheets, reports, and general information about energy codes and above-code resources.
- Graphics — Diagrams and photos that illustrate concepts related to energy codes and above-code construction.
- Online tools — Interactive web-based applications that guide users through energy code or above-code processes. An example is online energy code compliance or energy advisors.
- Presentations — PowerPoint documents detailing energy code topics and above-code presentations.
- Videos — Short clips that discuss building science, energy code, and above-code subjects.

The Resource Center gathers content from the Building Energy Codes Program's (BECP) own archives as well as from other resources such as state code activities, ENERGY STAR®, Building America, building scientists, and code groups. Users can research topics by category using the Browse menu, or by keyword using the SEARCH feature. While visiting the Resource Center, users also can link to REScheck™ BECP's energy code compliance software that is now used in many states.

The Resource Center is the product of years of work by DOE's Building Energy Codes Program and has been developed to provide a central point of access to energy code and construction information.

Link to the Resource Center from BECP's Website at www.energycodes.gov or go directly to http://energycode.pnl.gov/cocoon/energy/

# COM*check-Web*™
# New Web-Based Compliance Tool




Get all the functionality of the COM*check-EZ* desktop software over the internet with the new COM*check-Web* compliance tool. COM*check-Web* has the following features:

- Requires no download or installation of software on your desktop
- Demonstrates compliance to ASHRAE/IES Standard 90.1-1989, 1999, and 2001 or the 1998, 2000, 2001, or 2003 IECC.
- Performs the same compliance calculations as the desktop software
- Save your projects online for easy access anywhere there's an Internet connection
- Is continually updated so you always have the latest improvements to the software

Currently, COM*check-Web* does not include Lighting Allowances or Mechanical compliance, and state codes are not supported. If your project requires these features, we suggest you use the COM*check-EZ* desktop software. These features will be added in an update scheduled for September 2005.

To use this new tool go to http://energycode.pnl.gov/COMcheckWeb/

# RES*check-Web*™ and RES*check* Package Generator: Now helps demonstrate compliance to the 2003 IECC and offers on-line permitting

You can now email your compliance report to your local code official using RES*check-Web* and the RES*check* Package Generator.

Using RES*check-Web*: Click on the radio button "Reports" at the top of the screen page after the project is checked for compliance and is passing.

Using RES*check* Package Generator: Click on the radio button "Create PDF Report" at the top of the screen page after a compliance package has been chosen and applicable information has been entered on the web-based worksheet.

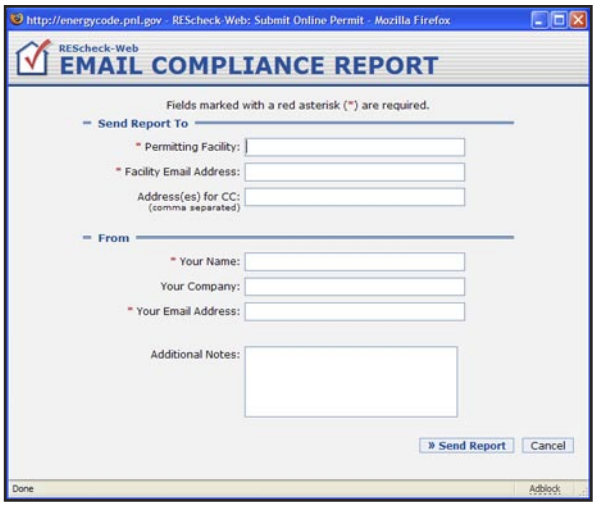



*Figure 1*

The screen shown in Figure 1 will appear. Fill in all the required information and submit your report. Contact your building department for the correct email address and to make sure they will accept electronic reports prior to submitting.

# Desktop Tools Now Offer Electronic Submittal

The new software desktop versions, RES*check* 3.6 Release 2 and COM*check-EZ* 3.0 Release 2 (released January 2005), now offer you the option of submitting compliance reports electronically to your building department directly from within the program.

A new feature called "Email Report" (see Figure 2) has been added to the File Menu. To use this feature the user must be connected to the internet.

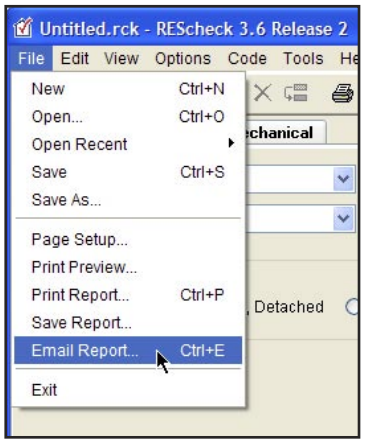



*Figure 2*

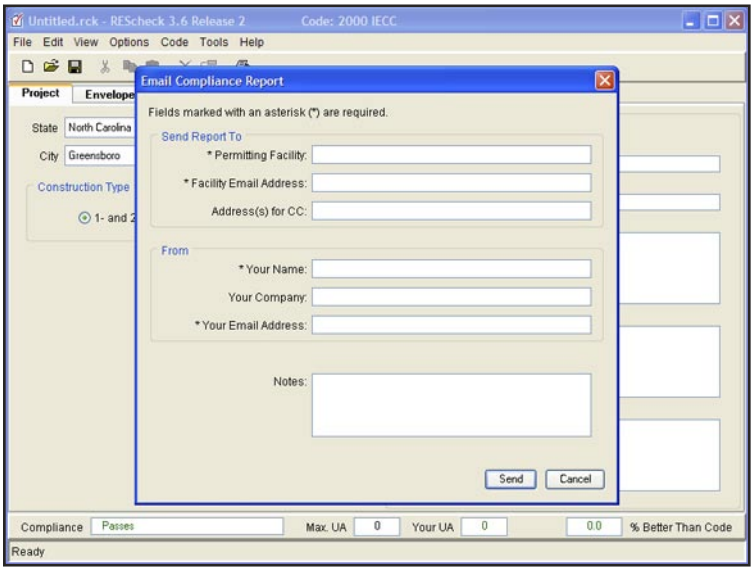



*Figure 3*

Fill in all the required information shown in Figure 3 and submit your report. Contact your building department for the correct email address and to make sure they will accept electronic reports prior to submitting.

# Upcoming Training Events

## • Live Web-based Training on How to Use REScheck

### May 6, 2005, 9:00 a.m. to 10:30 a.m. Pacific Standard Time

The 90-minute, live demonstration will provide an overview on how to use REScheck code compliance software. A case study approach including construction drawings will be used. Documentation of the compliance certificates and inspection checklists will also be reviewed.

For more information and to register on-line visit http://www.energycodes.gov/training/webex/rescheck.stm

## • Coming Soon... Live Web-based Training on How to Use COM*check-EZ*

Stay tuned for more information at http://www.energycodes.gov/

## • 4th Annual Design and Trade Professionals Conference

### March 24, 2005

Cromwell, CT
http://www.state.ct.us/dps/DFEBS/conference_information.htm

Mark Halverson, Pacific Northwest National Laboratory, will be demonstrating how to use the energy code software compliance tools RES*check* and COM*check-EZ*.

## • Lightfair International

### April 10-14, 2005

Jacob K. Javits Convention Center
New York, NY
http://www.lightfair.com/lightfair/V40/index.cvn?ID=10001

Visit the Building Energy Codes Booth #858 at the Trade Show, April 12-14 for hands-on software training using COM*check-EZ*.

## • AIA 2005 National Convention and Design Exposition

### May 19-21, 2005

Mandalay Bay Convention Center
Las Vegas, NV
http://www.aiaconvention.com/live/61/events/61LAS05A

Visit the Building Energy Codes booth #2154 offering continuing education learning units and hands-on software training using COM*check-EZ* and RES*check*.

## • AUSTIN, TEXAS - HERE WE COME!

### Mark Your Calendars!

The 2005 National Workshop on State Building Energy Codes is scheduled for June 27-30, 2005, at the Austin Marriott at the Capitol. For additional information, visit: www.energycodes.gov/news/2005_workshop/

U.S. Department of Energy
Energy Efficiency and Renewable Energy

**A Strong Energy Portfolio for a Strong America**

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.

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